APPENDIX C

Phipps Ocean Park Beach Restoration Project
Town of Palm Beach, Palm Beach County, Florida
Cumulative Impact Assessment Report

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1.0 INTRODUCTION

Dial Cordy and Associates Inc. (DC&A) was authorized by Coastal Technology Corporation (CTC) to prepare a cumulative impact assessment for the proposed Phipps Ocean Park beach restoration project. The proposed action includes placement of beach quality sand on 1.9 miles of highly eroded beach between Florida Department of Environmental Protection (DEP) reference monument R-116 and R-126 in Palm Beach County (Figure 1). As defined in the SEIS, the proposed action will result in 3.1 acres of direct impact and minimal indirect impacts to nearshore hardbottom habitat. The project will have minimal short-term water quality impacts and will not adversely impact any federally or State listed species. The project will restore and protect dry nesting beach, thereby improving and restoring available nesting area for federally protected sea turtles. For purposes of this assessment, the author used the Council on Environmental Quality's (CEQ) regulations (40 CFR 1500-1508) implementing the procedural provisions of the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 et seq.) to define cumulative effects as follows:

> *The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions regardless of what agency (Federal or non- federal) undertakes such other actions (40 CFR 1508).*

The basic framework and guidance for the assessment follows procedural and analytical recommendations provided in the CEQ's Considering Cumulative Impacts Under the National Environmental Policy Act (1997) and in Methodologies and Mechanisms for Management of Cumulative Coastal Environmental Impacts (NOAA, 1995).

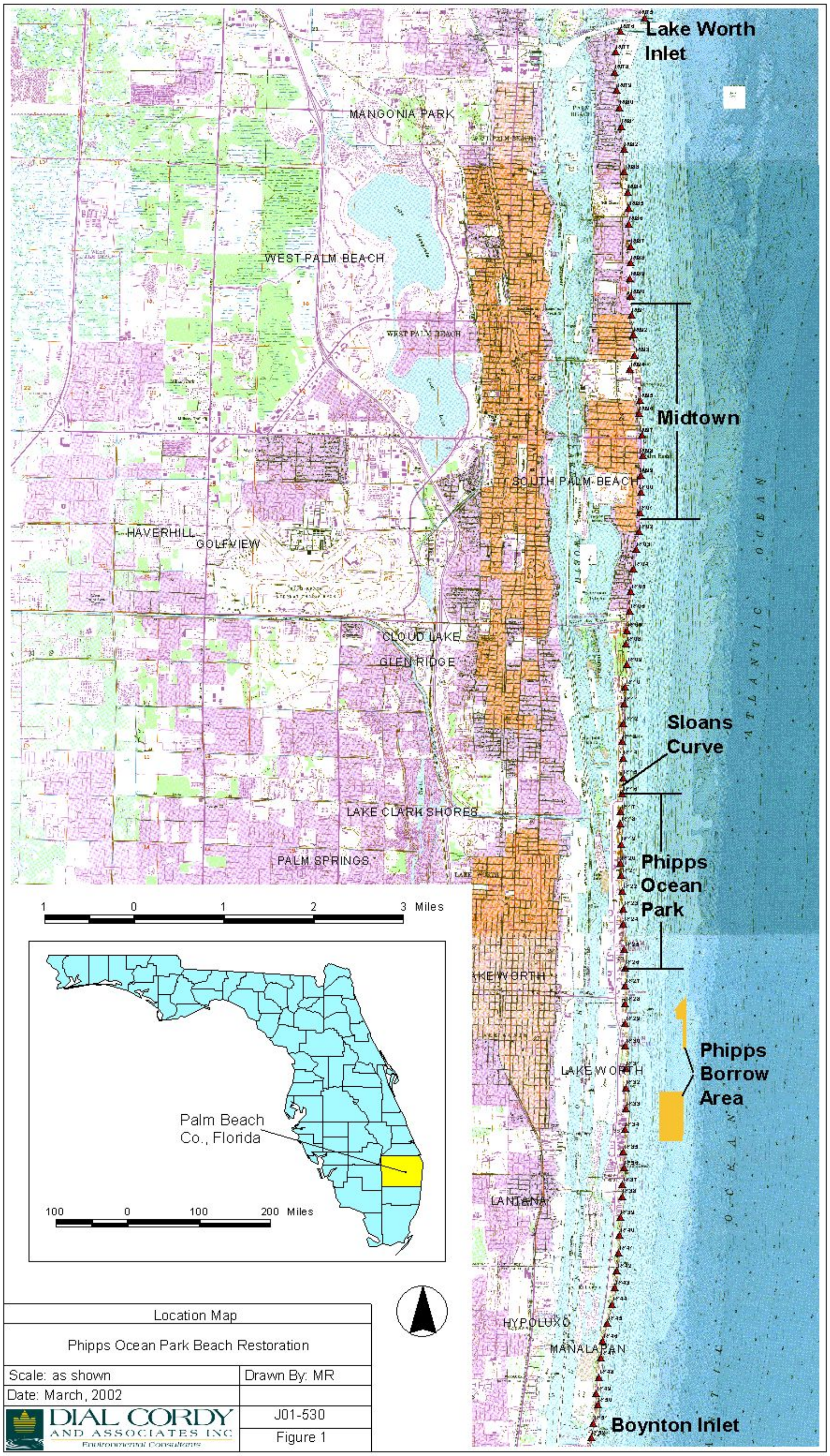


Figure 1 Location of the Future Phipps Ocean Park Beach Restoration Project

2.0 SIGNIFICANT CUMULATIVE EFFECTS AND ASSESSMENT GOALS

This section introduces cumulative effect issues with the proposed action and serves to define the assessment goals used for the analysis.

2.1 Cumulative Effects Issues

Issues selected for the analysis include nearshore hardbottom habitat and associated marine flora and fauna, sea turtle foraging and nesting habitat, and sea turtle nesting activity. Other issues such as water quality are not significant and have not caused great concerns in the past, as variances have been granted for mixing zones near the dredge operation, and State water quality standards must be adhered to during beach placement. Softbottom infaunal communities, as found in the borrow areas and sub-tidal beach fill areas, are not included in this analysis as the resource is plentiful and resilient. While socioeconomic issues are important with regards to use of the recreational beaches, they are not major issues that would result in any cumulative impacts. Activities considered secondary or as an indirect consequence of beach placement, include the spreading and re-deposition of sand over nearshore hardbottom areas outside the direct fill template years after the initial beach placement.

Sand movement from the nourished beach may result in reduction in the biodiversity associated with the hardbottom habitat beyond the fill template. However, the ephemeral nature of this nearshore habitat is well known (DC&A, 2000). Natural events such as storms, hurricanes and the movement of sand as part of the littoral process, all influence the temporal and spatial exposure of the rock habitat and the biotic integrity and ecological value of the resource. The nearshore hardbottom habitat is an important resource for numerous demersal and insular species of fishes, some of which temporally use the habitat for shelter as they move from the inshore areas to offshore reefs. Bait fishes and some migratory species will also use the habitat during annual migrations for foraging and shelter. The sessile and motile invertebrates common to the nourishment site have been documented (CSA, 2000; CTC, 2002). The biotic community associated with this habitat is principally an algal-sponge community with commonly interspersed patches of worm rock formed by the polychaete *Phragmatopoma lapidosa*, and some soft corals. The cumulative effect of proposed actions on the biodiversity of this habitat is of key importance, especially when considering the possibility of projects in the foreseeable future, which when considered cumulatively may have a significant impact.

The value of dry sandy beaches as nesting areas for sea turtles in the study area is well documented (PBCDERM, 2001). Of the three species of marine seas turtles (loggerhead, green, and leatherback) that nest along the study area, loggerhead are by far the most abundant. Based on a review of nesting data, the total number of loggerhead turtle nests ranged from 193 to 302 (mean = 190 nests/3,700 ft) over a six year period from 1996 to 2001, at Lake Worth Inlet (from 200 ft north and 3,500 ft south of the Inlet, respectively). During the same time period, the total number of green and leatherback nests ranged from 0 to 3 (mean = 1 nest/3,700 ft) and 1 to 18 (mean = 6 nests/3,700 ft), respectively. For the entire Palm Beach County (ca. 61.2 km), the total number of loggerhead, green, and leatherback nests ranged from 11,592 to 15,284 (mean = 13,660), 194 to 1,278 (mean = 901), and 94 to 221 (mean = 157), respectively over a five year period from 1996 to 2000. Sea turtle nesting habitat and nesting success are critical issues to be addressed in a cumulative fashion in this document.

2.2 Assessment Goals

The goal for this assessment was to address the cumulative effects of historic, proposed and future beach nourishment activities on nearshore hardbottom habitat and biodiversity, the use and value of the hardbottom resource as foraging habitat, and the effects on sea turtle nesting habitat and activity. In particular, the areas used for the assessment include the Phipps Park project area, the Town of Palm Beach, and the area between Lake Worth Inlet to South Lake Worth Inlet, referred hereafter as the Study Area.

2.2.1 Town of Palm Beach

Town, County, and State agency staff were contacted to compile a local database on beach restoration projects from the past, present, and foreseeable future and their impact on nearshore marine resources.

2.2.2 Study Area

The assessment tools for evaluating area trends in the presence and extent of the nearshore hardbottom habitat were ArcView GIS and the ERDAS multi-spectral image analysis software. Nearshore habitat found throughout the County was mapped and classified. The location and area of nearshore hardbottom habitat along areas of the County in 1985, 1993, and 2001 was determined using aerial photography. The aerials were digitized, rectified in Arc View and the landward limit of nearshore rock habitat delineated through ERDAS multi-spectral image analysis, where possible. The 1985 and 1993 nearshore limit was then compared with the 2001 map layer and the change in area along the County shoreline determined with ArcView.

ArcView GIS applications and the above aerials were also used to determine the historic change in area of nesting habitat for sea turtles along Palm Beach Island. Historic sea turtle nesting data was obtained from the State to establish trends in nesting density and nesting success. Trends in historic nesting areas and sea turtle nesting density were then compared to determine whether any correlation exists between the data sets.

Literature from previous studies within the County and elsewhere in the region on the biotic communities associated with the nearshore resources and effects of beach restoration activities were compiled and reviewed to assist in projecting cumulative effects on biodiversity in the nearshore zone.

3.0 GEOGRAPHIC SCOPE OF ANALYSIS

The geographic areas addressed in the analysis are defined in this section, and include the beaches of Palm Beach Island in the study area, as defined in the Comprehensive Coastal Management Plan Update for Palm Beach (ATM 1998). While the Town of Palm beach has served as the local sponsor for beach management planning for the Island, other municipalities including Manalapan and Lantana are located south of the Town. The Phipps Project Impact Zone includes the limits of the Phipps Ocean Park restoration project as currently proposed. The Other Projects Impact Zone encompasses the same geographic area as the study area, excluding Phipps Ocean Park.

3.1 Phipps Project Impact Zone

This zone includes the 1.9 miles of beach surrounding Phipps Ocean Park, downdrift beaches, and the nearshore hardbottom habitat and associated biota located immediately offshore (Figure 1).

3.2 Other Project Impact Zone

This zone includes the project areas for beach fill associated with other projects under consideration by the Town of Palm Beach. This zone includes projects located in Reaches 2, 5, 8, and Mid-Town (Reaches 3 & 4) as outlined in the Comprehensive Coastal Management Plan Update (ATM, 1998).

4.0 TIME FRAME FOR ANALYSIS

During agency scoping for this project it was agreed by all attending that the best time frame for the cumulative analysis was from 1980 through 2012. Aerial photography from 1985, 1993, and 2001 was deemed the highest quality for analytical use. A description of the time frame for past, present and future actions is defined below.

4.1 Past Actions (1980-2001)

Past actions include all definable activities which have occurred between 1980 and 2001. Significant actions that may have had an effect on the spatial exposure of nearshore hardbottom habitat and the erosional and depositional cycle on downdrift beaches south of Lake Worth Inlet did occur as early as 1918 when the inlet was first constructed. However, high quality aerials for delineating the nearshore hardbottom were not available until 1985. Consequently, aerials do exist but they are inadequate to allow for quantification of actions prior to 1985.

4.2 Proposed Actions (2002-2004)

Proposed actions within the study area include those projects which will be constructed between 2002 and 2004 and includes the Mid-Town renourishment and the restoration of Phipps Ocean Park, both of which will be authorized through issuance of a 10-year permit by the U.S. Army Corps of Engineers (USACE) and the Florida Department of Environmental Protection (DEP.) This permit for Phipps Ocean Park will allow the Town to construct 1.9 miles of beach within the 10-year life of the permit (FY 2002). Based on the present design, the renourishment interval required to maintain the design contours for the beach is 8 years. However, renourishment of the project is presently not funded, nor is it on the State's list for consideration. To be conservative for purposes of this analysis, any proposed direct burial of productive hardbottom habitat through sand placement will be considered as a permanent loss of the resource. If one reviews the history of beach nourishment in southeast Florida, it is highly likely that a beach once restored, has a high probability of being renourished in the "reasonably foreseeable future" (i.e., Delray Beach, Fort Pierce, Town of Jupiter Island, Broward and Dade counties).

4.3 Future Actions (2005-2012)

Future actions are those that may take place between 2005-2012 within the study area, based on selection of projects on the State's list for the study area as funded or pending through 2012 (new beach fill or renourishment).

5.0 ACTIONS AFFECTING THE RESOURCES

Actions which have in the past or are projected to, in the present or foreseeable future, impact nearshore hardbottom resources, and threatened and endangered species and their nesting or foraging habitat are summarized in Table 1 with a more descriptive list in Appendix A. For past, present and future actions, impacts are assessed within each geographic boundary or zone (Phipps Project Impact Zone, Other Projects Impact Zone). Since no projects have or are proposed to occur within the area outside of the sponsorship of the Town of Palm Beach further analysis of the area south of the Town of Palm Beach is not warranted. A summary for each of the two zones is provided below.

Table 1 Summary of Past, Present, and Proposed Future Projects and Direct Hardbottom Impacts Within Lake Worth Inlet to South Lake Worth Inlet Region.

Project Name	Project Type	Permitted	Funding Approved	Project Length (ft)	Hardbottom Impact (acres)
Past (FY80-01)					
Lake Worth Inlet Sand Transfer Plant	Sand Bypassing	N/A	Yes	100	N/A
Lake Worth Inlet Maintenance Dredging	Nourishment	Yes	Yes	3,130	N/A
Mid-Town	Nourishment	Yes	Yes	5,400	0.32
Sloan's Curve	Dune Restoration	Yes	Yes	N/A	N/A
Present (FY02-04)					
Lake Worth Inlet Sand Transfer Plant	Sand Bypassing	N/A	Pending	100	N/A
Lake Worth Inlet Maintenance Dredging	Nourishment	Pending	Pending	3,130	N/A
Mid-Town	Renourishment	Pending	Pending	12,352	0
Phipps Ocean Park	Nourishment & Renourishment	Pending	Pending	10,032	3.1
Proposed Future (FY05-12)					
Lake Worth Inlet Sand Transfer Plant	Sand Bypassing	N/A	No	100	N/A
Lake Worth Inlet Maintenance Dredging	Nourishment	N/A	No	3,130	N/A
Mid-Town	Renourishment	N/A	No	12,672	0
Phipps Ocean Park	Renourishment	Pending	No	10,032	3.1
Reach 2	Nourishment	Conceptual	No	5,300	6.9
Reach 5	Nourishment	Conceptual	No	8,704	2.9
Reach 8	Nourishment	Conceptual	No	8,142	4.3

5.1 Past Actions (FY80-01)

A review of past beach restoration activities is provided in this section for each geographic zone, including the Project Impact Zone, Other Projects Impact Zone, and the study area (Table 1).

5.1.1 Phipps Park Project Impact Zone

The downdrift erosion caused by Lake Worth Inlet since 1918 has impacted Phipps Ocean Park. This erosion has affected the beach profile and area of exposed nearshore hardbottom and available sea turtle nesting area. The influence of the Inlet contributes to beach erosion and rock exposure downdrift of the Inlet. Between 1990 and 1997, the erosion rate for this area was estimated at approximately 35,000 cy/yr (See SEIS Section 3.2.3). There have been no past erosion protection projects within the Phipps Ocean Park area.

5.1.2 Other Project Impact Zone

The only erosion control activity performed in this area is the sand bypassing and nourishment activities at Lake Worth Inlet and Mid-Town, which began in 1980. From 1980 - 2000 these nourishment and bypassing projects have resulted in a total of 3,500,897 cy of material placed on the downdrift beach. The sand bypassing and nourishment activities at Lake Worth Inlet did not result in impacts to the hardbottom adjacent to the fill template. The Mid-Town nourishment project is the only activity that resulted in any impacts. This beach nourishment project in 1996 resulted in placement of 882,158 cy of fill material with an impact of 0.32 acres to nearshore hardbottom. In addition, there were dune restoration activities at Sloan's Curve in 1987, totaling 34,000 cy.

5.2 Present Actions (FY 02-04)

A review of present beach restoration activities is provided in this section for each geographic zone, including the Phipps Project Impact Zone and Other Projects Impact Zone (Table 1).

5.2.1 Phipps Park Project Impact Zone

The permit issued to the Town of Palm Beach by FDEP authorizes placement of approximately 1.5 million cy of compatible sediment onto approximately 1.9 miles of critically eroded beach between DEP reference monuments R-116 to R-126 (Figure 1). The recommended borrow source includes two sites located approximately 3,500 ft offshore and between 1.5 and 2.6 miles south of the fill area mid-point. The proposed action will result in 3.1 acres of direct impact to nearshore hardbottom habitat which will be mitigated through the creation of a minimum of a 3.1 acre artificial reef. This beach nourishment project has been determined to be sufficient in maintaining a beach along most of the project shoreline until the projected renourishment in 8 years.

5.2.2 Other Projects Impact Zone

In 2002, the Mid-Town beach nourishment project is scheduled, which involves placement of 1,400,00 cy of fill spread along 12,352 ft of shoreline (Table 1). No new direct impacts to nearshore hardbottom habitat are anticipated if permitted with the present design.

5.3 Future Actions (FY05-12)

A review of future proposed beach restoration activities is provided in this section for each geographic zone, including the Phipps Park Project Impact Zone and Other Project Impact Zone (Table 1).

5.3.1 Phipps Park Project Impact Zone

While not funded or approved for renourishment, Phipps Ocean Park will require renourishment by 2012 in order to maintain the same degree of storm protection, recreational beach, and dry nesting beach for sea turtles. No new direct impacts to nearshore hardbottom resources are anticipated (Table 1).

5.3.2 Other Project Impact Zone

Other areas that will require future renourishment include Mid Town and Reaches 2, 5, and 8 in the Town of Palm Beach; however, they have not received funding or permit approval. The preliminary estimated direct impact to nearshore hardbottom habitat from these actions is 14.1 acres (Table 1).

6.0 DESCRIPTION OF AFFECTED ENVIRONMENT

This section outlines the cumulative effects of this project on resources found in the study area. A thorough description of these resources is found in Section 3.0 of the SEIS. To adequately address cumulative impacts, the description of the affected environment as presented in this section, includes three types of information:

- Data or information on the status of the living marine resources associated with the nearshore hardbottom habitat, and nesting and foraging activities for protected species.
- Data or information that characterizes important stress factors affecting the above resources.
- Trend analysis for nearshore hardbottom resources and sea turtle nesting areas and nesting activity within the County.

6.1 Status of Assessed Resources and Ecosystems

This section includes a review of the resources present along the shoreline of Palm Beach Island. Nearshore habitats impacted by this project in the study area consist of nearshore rock and have different characteristics than those of offshore reef and hardbottom. A thorough comparison of these habitats is conducted in the SEIS (Sections 3.7.1 and 3.7.2).

6.1.1 Nearshore Hardbottom Habitat

In January and February 2000, the natural nearshore hardbottom characteristics were documented (Table 2) by conducting 31 video transects plotted perpendicular to the shoreline within the project area (CSA, 2000) (Figure 1). The transects were plotted between DNR monuments R-113 and R-128 where the mean water depth varied from 4 to 30 ft nearshore and offshore, respectively. Video documentation was recorded using Integrated Video Mapping System (IVMS) and a diver towed behind a boat using surface-supplied air and a high resolution color video camera. Figure 2 illustrates the nearshore hardground resources in the project area, as mapped using multi-spectral imagine analysis and 2001 color aerials.

Table 2 Nearshore Hardbottom Types and Acreages for Phipps Ocean Park, Palm Beach County, Florida

Bottom Type	Location	Substrate Type	Dominant Biota
Artificial Reef (< 1 acre)	R-115	Concrete	Algae, sponges, worm rock, hydroids
Hardbottom (20.7 acres)	R-113 to R-125	Exposed rock, sand-veneered rock, and scattered rock on sand	Algae, worm rock, sponges, soft corals
Sand (565.9 acres)	R-113 to R-128	Not reported	Burrowing anemone, arrowhead sand dollar

Sand was the most abundant substrate in the surveys. Biota observed within this zone included the burrowing anemone (*Ceriatharia* sp.) and the sand dollar (*Encope michelini*). *Encope michelini* was abundant starting at a depth of 20 ft and continuing eastward along each transect to a maximum depth of 30 ft.

Hardbottom was documented within the northernmost transects (DNR monuments R-113 to R-116) where the water depth ranged from 4 to 10 ft. This area consisted of either exposed or sand-veneered rock. The greatest degree of vertical relief (1-3 ft) was recorded along the eastern edge of the hardbottom outcrop. The western edge had considerably less vertical relief (< 2 ft). Sand-veneered rock was recorded at the southern region (DNR monument R-116) of the hardbottom area. The biota common to the deeper rock outcrops consisted of algae, sabellariid worm rock, sponges, and soft corals. These nearshore rock habitats are exposed to wave action, sediment transport, and varied water clarity. This habitat is very ephemeral in nature and the species associated with this habitat must be able to quickly recover from the stresses imposed by the environmental conditions.

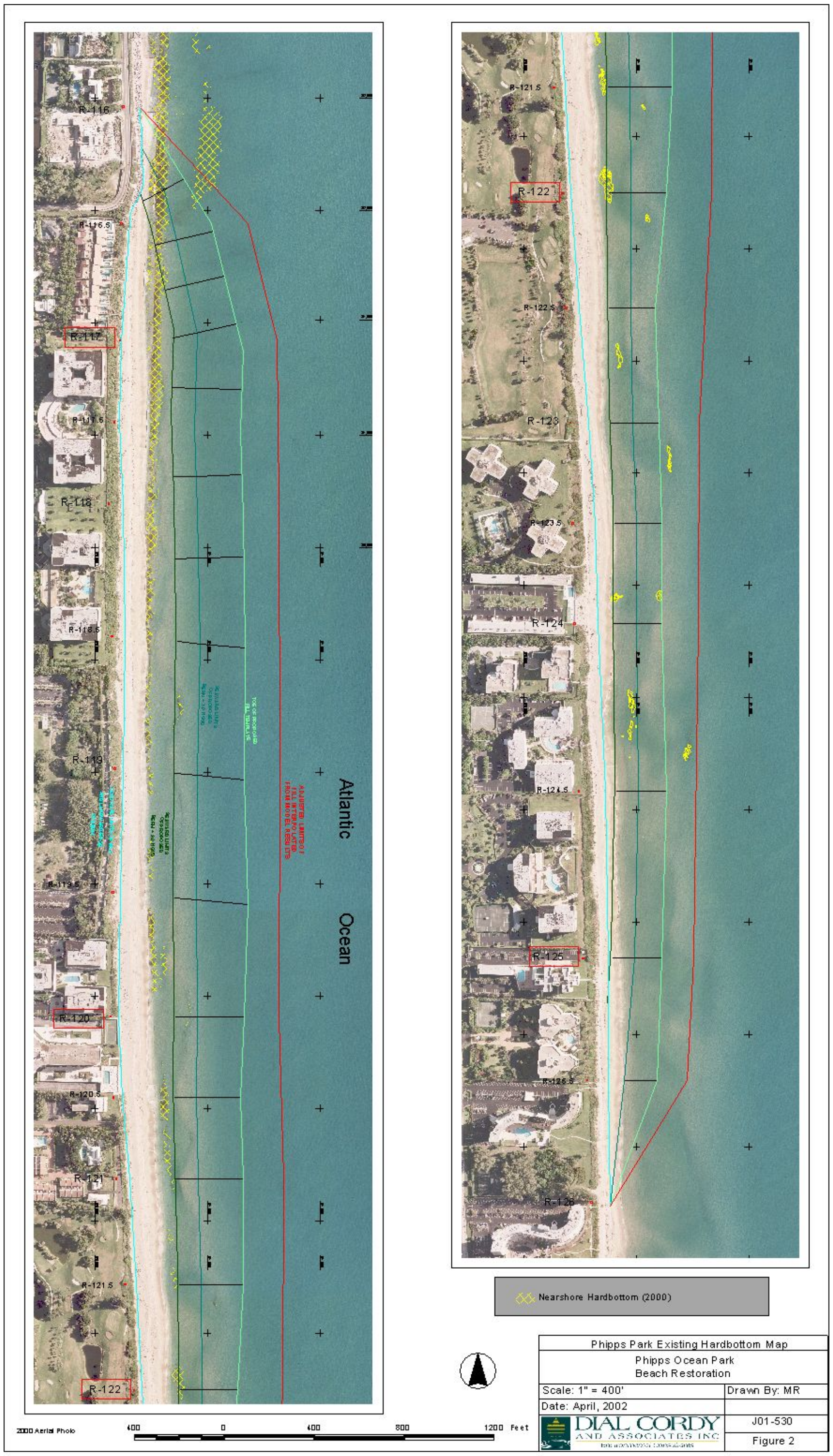


Figure 2 Phipps Park Existing Hardbottom Map

A small concrete artificial reef located in approximately 6.6 ft of water was observed along the nearshore section of DNR monument R-115. The reef, which was encrusted with algae, sponges, sabellariid worm rock, and hydroids, had a vertical relief of approximately 3.3 ft.

The remaining hardbottom area was located between DNR monuments R-116 and R-125, and the region parallel to the shore and the breakwater at a depth of approximately 6.6 ft. Exposed rock, scattered rock and sand, and sand-veneered rock comprised this hardbottom area. Low vertical relief consisting of sand-veneered rock and exposed rock was predominant in the northern nearshore (DNR monuments R-116 to R117.5) hardbottom region. This hardbottom area was located in shallow water and usually in the surf zone. Biota common to this hardbottom area was sabellariid worm rock and algae.

Exposed rock, sand-veneered rock, and rock on sand comprised the center section of the nearshore survey area (DNR monuments R-117.5 to R-122). Vertical relief along the eastern edge was approximately 1.6 to 3.3 ft with a maximum water depth of 6.6 ft. Although more fishes were observed in this area, attached biota on the rock was considerably less compared to the other nearshore survey areas to the north.

The hardbottom present in the southern region of the nearshore survey area (DNR monuments R-122.5 to R-125) consisted of exposed rock, sand-veneered rock, and rock on sand. The vertical relief in this area was less than that observed in the northern section and had less benthos attached to rocks than both the northern and central survey areas. A good deal of the rock substrate in the southern section appeared to be scoured by both wave action and sand.

A total of twenty-eight benthic species (Table 3) were identified by divers and during the post-survey analyses of the videotape and photoquadrat data (CSA, 2000). The rock substrate located along the north transects were colonized by sponges (*Dysidea* sp., *Monanchora* sp., and *Ircinia* sp.), sabellariid worm rock (*Phragmatopoma lapidosa*), and soft corals (*Psuedopterogorgia* sp., *Pterogorgia* sp., and *Muricea* sp.) The dominant species observed along the nearshore rock substrate parallel to the shoreline and in relatively shallow water included algae (*Caulerpa* sp., *Dictyota* sp., and *Padina* sp.), sponges (*Cliona* spp.), sabellariid worm rock (*P. lapidosa*), and hard coral (*Siderastrea radians*). Sabellariid worm rock was usually present in the shallow low relief rock substrate near the shorebreak. Colonies of hard coral (*S. radians*) were observed in an isolated area between DNR monuments R-120 to R-122 and near exposed rock outcrops located along the eastern transects.

Table 3 Dominant Marine Algae and Epifauna Observed Along the Video Survey Transects Conducted at Phipps Ocean Park, Palm Beach County, Florida.

Taxon	Common Name
Algae	
Botryocladia occidentalis	Red Algae
Caulerpa prolifera	Oval Blade Algae
Caulerpa racemosa	Green Grape Algae
Dictyota sp.	Branched Algae
Hypnea sp.	Red Algae
Padina sp.	Leaf Algae
Annelida	
Phragmatopoma lapidosa	Sabellariid Worm
Arthropoda	
Cirripedia (unidentified)	Barnacle
Plagusia depressa	Tidal Spray Crab
Ascidacea	
Didemnidae	Tunicate
Cnidaria	
Ceriatharia (unidentified)	Burrowing Anemone
Dichocoenia stokesii	Eliptical Star Coral
Diploria sp.	Brain Coral
Hydroida	Hydroid
Millepora sp.	Fire Coral
Muricea sp.	Sea Fan
Pseudopterogorgia sp.	Sea Plumes
Pterogorgia sp.	Sea Whip
Siderastrea radians	Lesser Starlet Coral
Echinodermata	
Encope michelini	Arrowhead Sand Dollar
Holothuroidea (unidentified)	Sea Cucumber
Mollusca	
Acanthopleura granulata	Fuzzy Chiton
Strombus alatus	Florida Fighting Conch
Porifera	
Cliona spp.	Yellow Boring Sponge
Dysidea sp.	Sponge
Holopsamma sp.	Sponge
Ircinia sp.	Sponge
Monanchora sp.	Sponge

A total of eighteen fish species (Table 4) were observed during the surveys conducted by CSA (2000). The most common fish species observed along the 31 video transects were sergeant majors (*Abudefduf saxatilis*), spottail pinfish (*Diplodus holbrooki*), black margate (*Anisotremus surinamensis*), chub (*Kyphosus* sp.), and hairy blennies (*Labrisomus nuchipinnus*). Both adults and juveniles of several of these species were observed. Greater abundances of fishes were observed in areas of greater vertical relief and near distinct ledges, especially between DNR monuments R-119 to R-122.5. The majority of the fishes observed along the transects are classified as resident species whereas the transient species were usually observed in deeper water and along sand substrate.

Table 4 Fishes with Residence Classification Observed Along the Video Survey Transects Conducted at Phipps Ocean Park, Palm Beach County, Florida.

Scientific Name	Common Name
Abudefduf saxatilis	Sergeant Major (R)
Acanthurus sp.	Surgeonfish (R)
Anisotremus surinamensis	Black Margate (R)
Anisotremus virginicus	Porkfish (R)
Archosargus probatocephalus	Sheepshead (R)
Carangidae	Jack (T)
Dasyatis americana	Southern Stingray (T)
Diplodus holbrooki	Spottail Pinfish (R)
Echeneis naucrates	Sharksucker (T)
Haemulon album	Margate (R)
Kyphosus sp.	Chub (R)
Labrisomus	Hairy Blenny (R)
Lutjanus griseus	Gray Snapper (R)
Rachycentron canadum	Cobia (T)
Rhinobatos lentiginosus	Atlantic Guitarfish (R)
Scaridae	Parrotfish (R)
Sphyraena barracuda	Barracuda (R)
Umbrina coroides	Sand Drum (R)

Classification Residence (R= Resident, T=Transient)

6.1.2 Indicator Species of Biological Integrity

Indicator species of biological integrity may include colonies of sabellariid worm rock and macroalgae located in the inshore hardbottom areas, along with several resident fishes considered common to the nearshore rock habitat. Unless buried by sand placement, none of these species would likely be adversely impacted by elevated suspended sediment on a temporary basis. Due to the dynamic and fluctuating physical environment along the shore, these species are highly adaptive to a wide range of environmental conditions.

6.1.3 Sea Turtle Nesting and Foraging Habitat

Five species of sea turtles are found in the waters off Palm Beach County, and three species have been documented as nesting on Palm Beach County beaches. The loggerhead is responsible for the vast majority of the nesting, although recent data shows an increasing statewide trend for nesting by the green turtle and particularly by the leatherback.

6.1.3.1 Loggerhead Sea Turtle (Caretta caretta)

The loggerhead sea turtle has been federally listed as a threatened species since 1978. Loggerheads are circumglobal in distribution in tropical and temperate waters. The southeast U.S. coast, and particularly Florida, is considered to be the most important rookery in the western hemisphere for loggerheads (NMFS and USFWS, 1991a). Loggerheads nest in the southeast U.S. from April through September, with peak nesting in June and July (NMFS and USFWS 1991a). The nesting process is remarkably stereotyped, and is described in Bustard et al. (1975). Hatchlings emerge primarily at night, and swim offshore in a “frenzy” until they arrive at offshore weed and debris lines (Carr, 1986; Wyneken and Salmon, 1992). Post hatchling turtles from the Florida coast enter the currents of the North Atlantic Gyre, eventually returning to the western Atlantic coastal waters (Bowen et. al., 1993). When loggerheads reach a carapace length (CL) of approximately 40-60 cm, they leave the pelagic environment and move into various nearshore habitats (Carr, 1986). In the United States, developmental habitats for loggerheads are found from Texas to Nova Scotia (Turtle Expert Working Group, 1998). As they approach adult size of about 83cm CL (Ehrhart et al., 1996) loggerheads leave the developmental habitats. Adult loggerhead foraging grounds for the south Florida nesting population are found in the Caribbean basin, the Gulf of Mexico, and along the eastern seaboard of the U.S. (Meylan et al. 1983). Abundances of adult loggerheads in Florida coastal waters are much lower in months outside of the nesting season (Magnuson et al., 1990).

Recent studies have revealed three genetically distinct nesting populations in the southeast U.S. which includes the northern nesting population (North Carolina to Cape Canaveral), the south Florida population (Cape Canaveral to Collier County), and the Florida Panhandle population (Franklin to Escambia Counties, Florida) (Bowen et al., 1993). Trends in Florida nesting were assessed by Witherington and Koppel (in press), who analyzed loggerhead nesting for thirty nesting beach sites in Florida and concluded that loggerhead nesting appeared to be stable or increasing over the period from 1989-1998. Along the 2 km section of beach from the south end of Sloan's Curve to the south boundary of the Par III Golf Course (including Phipps Ocean Park), the mean number of nests was 199.2 nests/km/yr from 1998 to 2000. A total of 1195 nests were observed during the same three year period. The mean nesting density for the entire County regarding loggerhead turtles was 217.5 nests/km/yr for the same three year period. Nesting densities are slightly lower within the project area.

6.1.3.2 Green Sea Turtle (Chelonia mydas)

The green turtle was listed under the Endangered Species Act in 1978, and the Florida nesting population is currently listed as endangered. Green turtles are found worldwide in tropical and subtropical waters. Major green turtle rookeries in the Western Hemisphere occur on South Atlantic islands and the Caribbean basin. Most continental U.S. nesting of the green turtle takes place on the Atlantic coast of Florida south of Cape Canaveral (NMFS and USFWS, 1991b). Green turtles show a similar life history pattern as loggerheads, but they leave the pelagic phase and enter developmental habitats at a considerably smaller size (~20-25cm CL (Magnuson et al., 1990). Typical developmental habitats are shallow, protected waters where seagrasses are prevalent (Carr et al., 1978), but small green turtles are also commonly found in reef environments where attached algae is present (Cone, 1994; Ehrhart et al., 1996). It has been suggested that green turtles in foraging habitats may tend to specialize in either algae or seagrass as individual turtles with intestinal microbial flora adapted to aid in seagrass digestion would digest algae less efficiently, and vice versa (Bjorndal, 1985). Green turtles nesting in Florida have a minimum size of 83.2 cm CL, but leave Florida developmental habitats at about 60-65 cm CL (Witherington and Ehrhart, 1989), perhaps migrating to the southeastern Caribbean. The majority of green turtle nesting in Florida takes place in July, August, and early September. Witherington and Koppel (in press) reviewed green turtle nesting on thirty beach sites included in the Florida Index Nesting Beach program. They concluded that green turtle nesting in Florida was stable or increased from 1989-1998.

Nesting activity of the green turtle in Palm Beach County was estimated from Florida Fish and Wildlife Conservation Commission (FFWCC) Statewide Nesting Beach Survey data. Along the 2 km section of beach from the south end of Sloan's Curve to the south boundary of the Par III Golf Course (including Phipps Ocean Park), the mean number of nests was 25.3 nests/km/yr from 1998 to 2000. A total of 152 nests were observed during the same three year period. The mean nesting density for the entire County regarding green sea turtles was 17.9 nests/km/yr. The nesting densities are slightly greater within the project area for the same three year period.

6.1.3.3 Leatherback Sea Turtle (Dermochelys coriacea)

The leatherback was federally listed as endangered in 1970. Leatherbacks are found worldwide in pelagic waters from the tropics to near the Arctic and Antarctic Circles. Nesting is primarily on the Pacific coast of Mexico and the Caribbean coast of South America, with some continental U.S. nesting in Florida. From 1979 to 1992, over 90% of Florida leatherback nesting occurred in St. Lucie, Martin, and Palm Beach counties (Meylan et al., 1995). An analysis of Florida Index Nesting Beach Survey data indicates a statistically significant increase in Florida leatherback nesting from 1989-1998 (Witherington and Koppel in press). Along the 2 km section of beach from the south end of Sloan's Curve to the south boundary of the Par III Golf Course (including Phipps Ocean Park), the mean number of nests was 1.67 nests/km/yr from 1998 to 2000. A total of 10 nests were observed during the same three year period. The mean nesting density for the entire County was 2.72 nest/km/yr for the same three year period. Nesting densities are slightly lower within the project area.

6.2 Characterization of Stress Factors

6.2.1 Nearshore Hardbottom Marine Resources

Stress factors affecting the benthic community associated with the nearshore hardbottom include sediment deposition, resulting in the burial of the algal/sponge community and loss of algal production (due to loss of light from excessive turbidity), and diminished biological integrity and diversity. These same stress factors can result in the loss of habitat for fish utilization due to reduced dissolved oxygen and water clarity rendering the area unsuitable for use by many fish species. It is important to note however that the benthic and fish species common to these hardbottom areas are highly adapted and tolerant of the wide range of physical conditions common to these dynamic nearshore areas in the County.

6.2.2 Sea Turtle Nesting Habitat

Stressors affecting sea turtle nesting activity following beach restoration include excessive compaction of the new dry beach, resulting in an increased frequency of false crawls; and differences in grain-size distribution on a new beach, which affects the nesting process and could increase the frequency of false crawls and reduce hatching success.

Restored beaches often differ from natural beaches regarding several important features that affect their suitability for sea turtle nesting. If sands used for restoration differ markedly from natural beach sands in grain size distribution and color, then sediment temperature, moisture content, and gas exchange may be affected, all of which may affect the nest incubation environment. Renourished beaches may show high levels of sand compaction, which affects the ability of turtles to nest, the incubation environment, and hatchling emergence success. These changes in physical characteristics, together with the unnatural “as-built” profile of the restored beach, may result in reduced reproductive success during one or more nesting seasons following construction. As restored beaches equilibrate to a more natural profile, steep vertical escarpments often form along the seaward edge of the constructed beach berm. These “scarps” present a physical barrier to nesting turtles. Additionally, as beach profiles equilibrate, losses of nests laid in the seaward portions of the renourished beach due to erosion may be high. A review of these potential impacts is provided by Crain et al. (1995). Steinitz et al. (1988) postulated a cyclical trend of impacts on nesting based on long term observations on a renourished beach at Jupiter Island, Florida. They found that nesting densities were low on highly eroded beaches, as might be expected. Following the construction of a beach restoration project, although the number of crawls increased, low nesting success caused the nest density to remain low. After two years post construction, nesting density was considerably higher than pre-construction levels and similar to non-eroded control beach. As the renourished beach eroded and narrowed, nest densities declined until they approached pre-construction levels. The next renourishment episode began the cycle again.

Most of the detrimental effects of beach nourishment projects have been limited to effects on nesting success (the proportion of turtles emerging from the sea that successfully nest) (Nelson and Dickerson, 1988). Reductions in hatching success (the proportion of eggs laid that hatch or result in emergent hatchlings) have been reported less frequently (Ehrhart, 1995; Ecological Associates, 1999). Trindell et al. (1998) provide a comprehensive review of sea turtle monitoring data associated with 27 beach restoration projects constructed in Florida since 1987. Where appropriate, data were pooled for statistical comparison with available background nesting data. Overall, they found that nesting success was significantly reduced in the first post-construction nesting season, but a significant difference was absent in the second nesting season post-construction. No significant differences in hatching success levels were evident in either the first or second year post construction between background levels and pooled project beaches.

6.3 Trend Analysis and Baseline Condition of Affected Resources in the Region

6.3.1 Nearshore Hardbottom Habitat

Trend analysis for the hardbottom resource assessment included mapping of the study area, using ERDAS imaging analysis software to define and characterize habitat types referred to in Section 6.1.1 of this report and analysis of past aerial photography and beach profiles to define the historic inshore limits of hardbottom. A comparison of these two data sets was rendered using GIS spatial applications to ascertain trends in the resource occurrences.

Appendix A contains results of the multispectral image analysis of nearshore hardbottom features for 1985, 1993, and 2001. Table 5 and Figure 3 summarizes the extent of nearshore hardbottom as determined by the multispectral analysis of the historic aerial set. Overall nearshore hardbottom decreased from 1985 to 2001.

Table 5 Hardbottom Acreages by Reach in 1985, 1993, and 2001

Reach	1985	1993	2001	Net Change 1985-1993	Net Change 1993-2001	Net Change 1985-2001
1	0.3	0.9	1.6	0.6	0.7	1.3
2	63.8	55.2	47.8	-8.6	-7.4	-16
3	54.9	45.8	43.1	-9.1	-2.7	-11.8
4	49.5	42.0	38.1	-7.5	-3.9	-11.4
5	26.9	30.3	20.7	3.4	-9.6	-6.2
6	12.7	26.9	27.6	14.2	0.7	14.9
7	2.1	1.3	2.5	-0.8	1.2	0.4
8	10.7	12.1	10.3	1.4	-1.8	-0.4
9	5.5	7.9	1.4	2.4	-6.5	-4.1
10	22.0	36.8	27.4	14.8	-9.4	5.4
11	4.2	6.5	2.1	2.3	-4.4	-2.1
Total	**252.6**	**265.7**	**222.6**	**13.1**	**-43.1**	**-30**

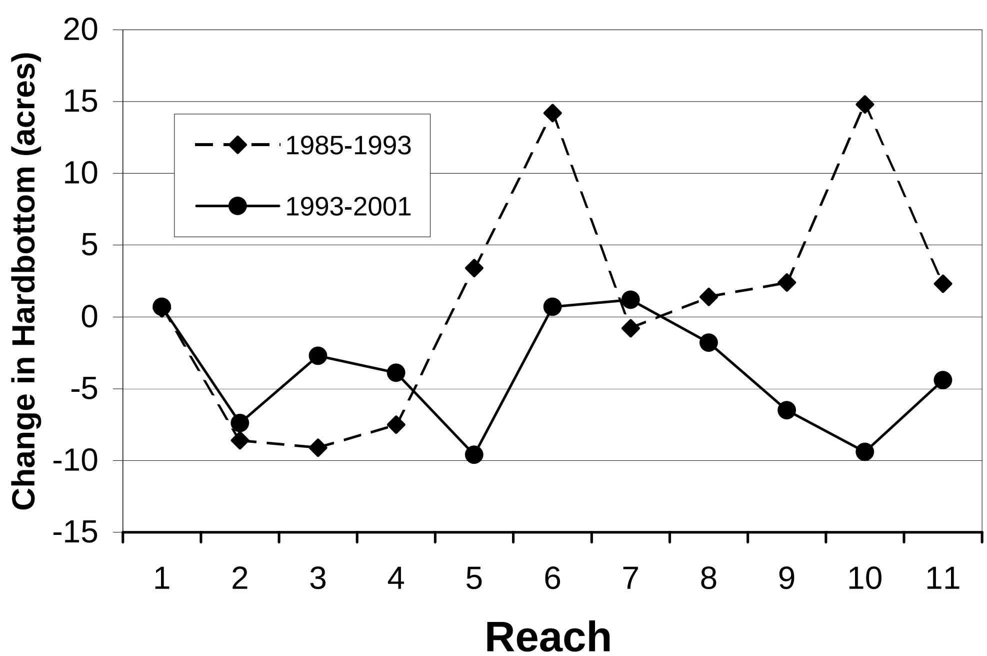


Figure 3 Hardbottom Acreages by Reaches from 1985 - 1993 and 1993 - 2001

A comparison between the 1985 and 1993 location of hardbottom resources between Lake Worth and South Lake Worth Inlets (DNR monument R-76 to R-151) show that the mean distance from the DNR reference monuments to the edge of hardbottom was 19.25 ft greater in 1993 (Table 6 and Figure 4). A similar comparison between the 1993 and 2001 location of hardbottom resources show that the mean distance from the DNR reference monuments to the edge of hardbottom was 13.36 ft less in 2001. Reaches 2 and 5 that were downdrift of where sand had been placed exhibited some of the highest losses in hardbottom from 1993 to 2001. Overall, the mean distance between the monuments and the edge of hardbottom increased by 5.89 ft from 1985 to 2001 (Table 6). Based on this analysis, it appears that the mean beach width increased from 1985 and the area of exposed hardbottom decreased. This is supported by the fact that the total hardbottom between Inlets was reduced by 30 acres from 1985 (252.6 acres) to 2001 (222.6 acres) (Table 5). Similar conclusions were observed for Phipps Ocean Park (DNR monument R-116 to R-126) where the mean distance from the shoreline to the edge of hardbottom was 6.67 ft greater in 2001 compared to 1985. Areas where the loss of beach was greatest for 1985, 1993, and 2001 was between R-76 and R-77 (encompasses Lake Worth Inlet), R-89 to R-101, R-104 to R-107 (encompasses Reach 5), and R-146 to R-149 (Figure 2).

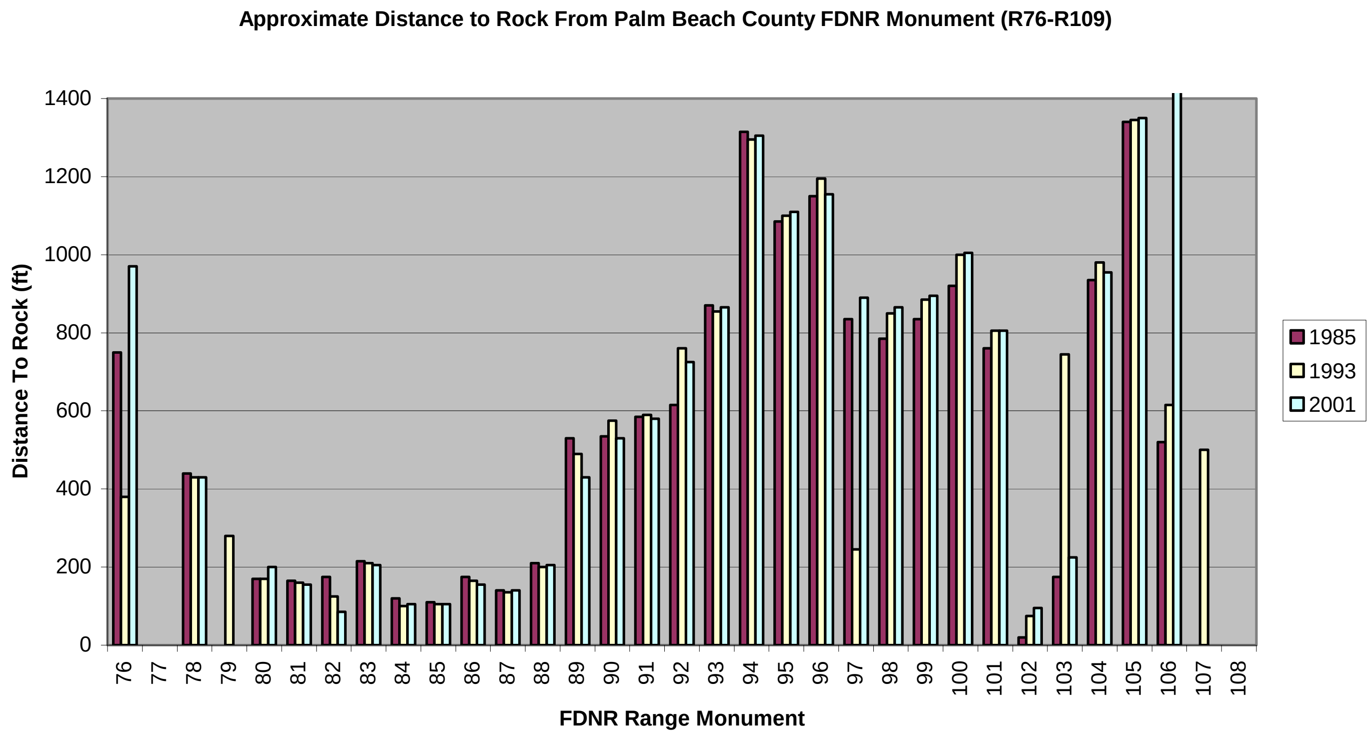
6.3.2 Sea Turtle Nesting Habitat and Foraging Area

Critically eroded areas of Palm Beach Island have experienced a cumulative loss of dry nesting beach (Figures B1-B6, Appendix B). The greatest loss in dry beach from 1985 - 1993 was at Reach 6, followed by Reaches 5 and 4, for a total loss of 8.5 acres (Table 7). However, based on the erosion and accretion events along Reaches 1 - 11 during this same time period, there was a net gain of 15.8 acres of dry beach (Table 7). The greatest loss in dry beach from 1993 - 2000 was Reach 2, followed by Reaches 5, 9, and 7, for a total loss of 7.6 acres (Table 7). However, based on the erosion and accretion events along Reaches 1 - 11 during this same time period, there was a net gain of 17.2 acres of dry beach (Table 7). These changes in dry beach were based on changes in the MHW line for given time intervals. The MHW line data was acquired through the DEP databases.

The sea turtle nesting data per Reach is incomplete due to inconsistencies regarding survey sites prior to 1998 (Table 8). Consequently, it was impossible to determine the number of nests per species for each of the designated Reaches prior to 1998. However, from the data that could be assigned to specific Reaches, a noticeable increase in the number of turtle nests occurred after 1993 which corresponds with sand bypassing activities. This is further supported by the fact that from 1993 -2000 that there was a significant loss in hardbottom (Table 5) due to sand bypassing activities. It would appear that sea turtles were able to take advantage of the increase in dry beach acreage from the sand bypassing activities, at the expensive of hardbottom habitat loss. Although green turtle nesting densities fluctuated widely, in general, sea turtle densities for the entire County revealed an overall increase especially after 1993 (Figure 5).

Table 6 Distances Between Monuments and Hardbottom Locations Between Lake Worth Inlet and South Lake Worth Inlet in 1985, 1993, and 2001.

	DNR	1985	1993	2001		DNR	1985	1993	2001
Reach 1	R-76	750	380	970	Reach 6	R-114	140	100	80
	R-77					R-115	115	105	90
	R-78	440	430	430		R-116	135	105	95
Reach 2	R-79		280		Reach 7	R-117	220	185	190
	R-80	170	170	200		R-118		165	175
	R-81	165	160	155		R-119		140	140
	R-82	175	125	85		R-120			195
	R-83	215	210	205		R-121			240
	R-84	120	100	105		R-122		195	190
	R-85	110	105	105		R-123			
	R-86	175	165	155		R-124	150		
	R-87	140	135	140		R-125			
	R-88	210	200	205	Reach 8	R-126			
	R-89	530	490	430		R-127			
	R-90	535	575	530		R-128	170		
Reach 3	R-91	585	590	580		R-129	175		
	R-92	615	760	725		R-130	155		155
	R-93	870	855	865		R-131	130	175	155
	R-94	1315	1295	1305		R-132	155	410	140
	R-95	1085	1100	1110		R-133	140	390	150
Reach 4	R-96	1150	1195	1155		R-134	125	435	
	R-97	835	245	890	Reach 9	R-135	110	490	160
	R-98	785	850	865		R-136	75	80	
	R-99	835	885	895		R-137	115	120	110
	R-100	920	1000	1005	Reach 10	R-138	120	125	115
	R-101	760	805	805		R-139	185	215	215
	R-102	20	75	95		R-140	100	280	150
Reach 5	R-103	175	745	225		R-141	100	275	145
	R-104	935	980	955		R-142	75	100	115
	R-105	1340	1345	1350		R-143	80	100	115
	R-106	520	615	1715		R-144	140	145	150
	R-107		500			R-145	310	290	150
	R-108				Reach 11	R-146	430	405	415
	R-109		245			R-147	540	360	540
	R-110		105	135		R-148		650	
Reach 6	R-111		125	115		R-149	1365	1360	
	R-112	175	170	105		R-150			
	R-113	210	170	170		R-151			
						MEAN	**393.33**	**412.58**	**399.22**



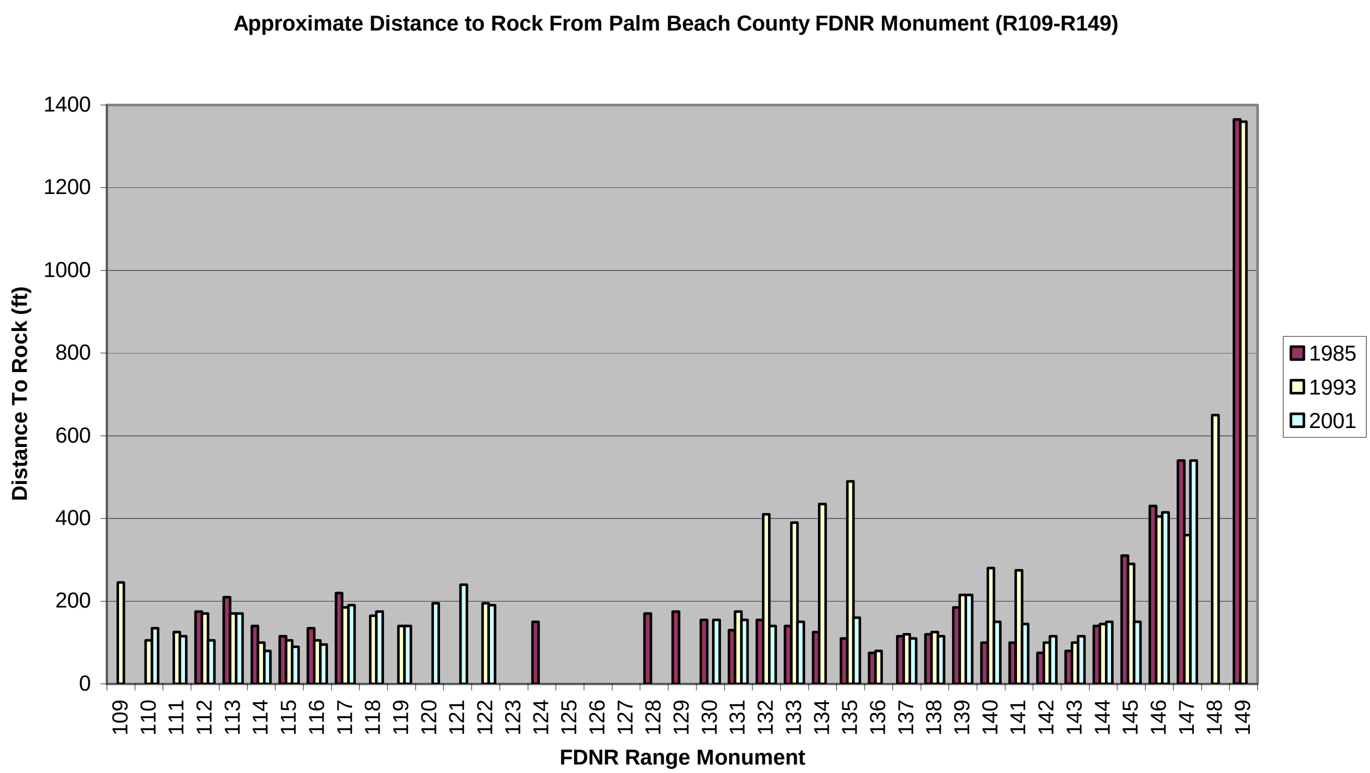


Figure 4 Distances Between Monuments and Hardbottom Locations Between Lake Worth Inlet and South Lake Worth Inlet in 1985, 1993, 2001

Table 7 Net Change in Area of Dry Beach for Sea Turtle Nesting from 1985 - 2000

Monument	Reach	Erosion (acres)	Accretion (acres)	Net (acres)
1985 - 1993				
R-76 to R-78	1	0.0	3.2	3.2
R-79 to R-90	2	3.2	4.0	0.8
R-91 to R-95	3	0.0	6.7	6.7
R-96 to R-102	4	4.2	1.9	-2.3
R-103 to R-110	5	4.8	1.9	-2.9
R-111 to R-116	6	3.3	0.0	-3.3
R-117 to R-125	7	0.9	4.2	3.3
R-126 to R-134	8	0.9	5.9	5.0
R-135 to R-137	9	0.0	1.2	1.2
R-138 to R-145	10	0.0	2.1	2.1
R-146 to R-151	11	0.1	2.1	2.0
Total		**17.4**	**33.2**	**15.8**
1993 - 2000				
R-76 to R-78	1	0.0	10.1	10.1
R-79 to R-90	2	6.6	4.1	-2.5
R-91 to R-95	3	2.2	2.7	0.5
R-96 to R-102	4	0.2	10.0	9.8
R-103 to R-110	5	3.4	1.6	-1.8
R-111 to R-116	6	0.1	3.9	3.8
R-117 to R-125	7	3.2	1.6	-1.6
R-126 to R-134	8	2.1	2.7	0.6
R-135 to R-137	9	1.7	0.0	-1.7
R-138 to R-145	10	1.0	1.0	0.0
R-146 to R-151	11	1.1	1.1	0.0
Total		**21.6**	**38.8**	**17.2**

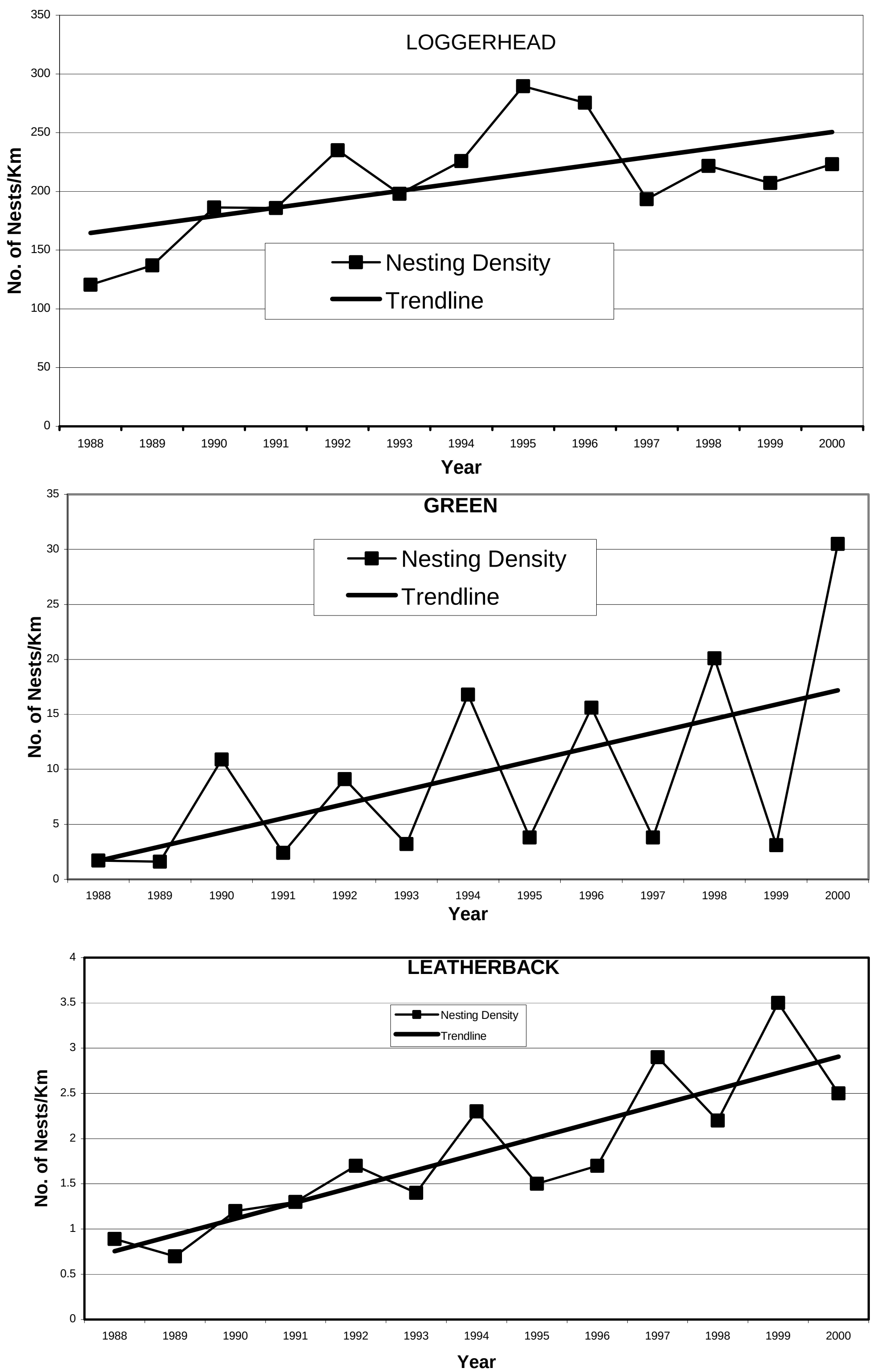


Figure 5 Palm Beach County Sea Turtle Nesting Densities From 1988 to 2000

Table 8 The Number of Turtle Nests by Reach For 1985, 1993 and 1993 - 2000

	Loggerhead			Green			Leatherback		
Reach	**1985**	**1993**	**1998-00[1]**	**1985**	**1993**	**1998-00[1]**	**1985**	**1993**	**1998-00[1]**
1			156.6			1.65			0.88
2									
3			34			0.5			0.5
4		126	147.7		0	1.67		0	2.3
5									
6									
7			263.2			28.4			3.5
8	3	3	109		0	7.7		0	1.5
9	3	7	69.5		1	5.8		0	0.8
10		197	124.5		0	10.4		1	1.8
11		162	180.6		0	14.9		1	1.8

[1] Figure represents the mean number of turtle nests for the three years combined.

This loss in dry beach appears to have had little affect regarding the nesting densities of loggerhead, green, and leatherback sea turtles. The net increase in dry beach from 1985 - 1993 and 1993 - 2000 was 15.8 and 17.2 acres, respectively (Table 7). Although the nesting density of each of the three sea turtle species has fluctuated.

It is expected that beach restoration after the first year will not have an adverse impact on nesting activity. In fact with more nesting area available this may increase nesting activity. Nearshore hardbottom habitats may also serve as foraging habitat for juvenile turtles with the study area (Carr, 1986). As the hardbottom resource is not limited, even with full implementation of all proposed future projects in the County, loss of the foraging habitat is not presently considered a significant cumulative impact on sea turtles. A review of the impacts of beach restoration within the study area demonstrates that even with full implementation of all proposed projects there will be no adverse cumulative impact on sea turtle nesting activity through FY 2012.

7.0 CAUSE AND EFFECT RELATIONSHIP

Cause and effect relationships for beach restoration activities have been established along the east coast of Florida, generally as a result of comparing baseline conditions prior to a beach fill project, with resource conditions up to three to five years following the project. Monitoring has included photographic analysis of the nearshore habitat to assess changes in biotic cover, integrated video mapping to document changes in rock exposure and habitat type, and visual fish surveys of the hardbottom resource prior to and following the project. No efforts have been made to evaluate the spatial or cumulative impact on the hardbottom resources, as a result of many projects over multiple years, such as might be expected in Broward and Dade counties. While these studies did document loss of habitat and indirect impacts such as reduced biotic cover, a clear causal relationship to only the beach fill activity cannot be made due to the dynamic and ephemeral nature of the resource, which is subject to constant change as a result of natural and man-induced coastal processes and storm events. While direct habitat loss and the linkage to beach fill can be clearly established, quantifying indirect impacts and temporal changes in the resource base has been difficult.

Due to the abundant areal extent of the hardbottom in the Phipps Park Impact Zone and the Other Project Impact Zone (Table 9), a direct loss of 17.2 acres through 2012 may not be considered significant, especially if the resource base has the capacity to support and maintain the biodiversity impacted by a few projects. The total area of nearshore hardbottom cover, as mapped for the whole study area was 222.5 acres (Table 9). Additionally, mitigation of impacts to nearshore hardbottom within the Project Impact Zone, through the creation of a 3.1 acre artificial reef as cited in the DEP permit, will tend to counteract direct loss of hardbottom habitat.

Table 9 Net Change in Hardbottom Area for the Project Impact, Proposed Future, and Regional Institutional Zone

	Total Hardbottom Resource Base[1] (acres)	Cumulative Direct Loss (acres)	Net Balance
Project Impact Zone	3.1	3.1	0.0
Other Project Impact Zone	219.4	14.1	204.5
Total	222.5	17.2	204.5

[1] Based on mapping to 1,500 ft offshore.

8.0 MAGNITUDE AND SIGNIFICANCE

8.1 Magnitude of Cumulative Affects

Although many of the original shoreline management initiatives have been implemented as outlined in the Comprehensive Coastal Management Plan prepared by the Town of Palm Beach in 1986, the beach shoreline is still eroding at a significant rate. Between 1990 and 1997, the mean erosion rate was approximately 220,239 cy/yr for Palm Beach Island. If all past, present, and future proposed projects are funded, permitted, and constructed, of the total 222.5 acres of nearshore hardbottom in the study area (1,500 ft from shore), approximately 17.2 acres are projected to be directly impacted over the next ten years (Table 9).

8.2 Significance of Cumulative Affects

Due to the paucity of actual research and long term monitoring on nearshore hardbottom communities, determining what amount of cumulative impact is significant is difficult. Past impacts within the region are minimal and do not appear to have had any adverse or significant cumulative impact on the resource, even when combined with present actions proposed to occur within two years. Proposed future actions within the County do add cumulatively to the impact and are adverse. Due to the significant amount of adjacent habitat remaining, it is unlikely that the amount of hardbottom habitat will become a limiting resource. With this in mind, the impacts are likely to be considered adverse, but not significant, since the adjacent habitat is clearly not limited.

9.0 MITIGATION OF CUMULATIVE EFFECTS

Since the preferred plan involving restoration of Phipps Ocean Park does not by itself result in more than an adverse cumulative impact, additional mitigation for cumulative impacts as outlined in the FDEP permit is not warranted.

10.0 MONITORING AND ADAPTIVE MANAGEMENT

A monitoring plan which includes both physical (e.g., sand quality, turbidity) and biological (e.g., juvenile green turtle, fish and invertebrate community, mitigation artificial reef) parameters has been developed as outlined in the DEP permit issued under the authority of Chapter 161 and Part IV of Chapter 373, Florida Statues (F.S.), and Title 62 and 40, Florida Administrative Code (F.A.C.). The overall goals of the monitoring will be to determine the fate and affect of fill material on nearshore hardbottom communities, and assessing both the direct and indirect impacts of the project.

11.0 AVOIDANCE AND MINIMIZATION OF ADVERSE AFFECTS

Efforts to avoid and minimize adverse impacts to living marine resources were undertaken during the design of the project. Alternative designs considered for restoration are described in Section 2.0 of the Draft SEIS for the area surrounding Phipps Ocean Park (CTC/ DCA, 2002).

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APPENDIX A

Study Area Hardbottom Maps 1985, 1993, and 2001

Figure A-1 to A-6
To be inserted manually

APPENDIX B

Erosion/Accretion Maps 1985-1993, 1993-2000

Figure B-1 to B-6
To be inserted manually